REMARKS

This is in response to the Office Action that was mailed on April 18, 2002. Claim 1 has been amended to specify that the rings Z are adamantane rings, as specified in original claim 11, and to require that at least one of the R^4 substituents is a oxygen-containing group – see for instance claim 8 in its original form. The listing of oxygen-containing groups introduced into claims 1 and 9 comes from original claim 4 (see also the specification, page 9, line 26 through page 10, line 13). The phrase "a hydrogen atom or" has been deleted from the definition of R^2 in claims 2 and 8 because it is not permitted by the definition of R^2 in claim 1 from which they depend. The proviso that "all R^4s are not concurrently hydrogen atoms" in claims 1 and 7 has been canceled as superfluous, in view of the claim 1 requirement that at least one of the R^4s be an oxygen-containing group. In addition, minor formal amendments have been made. No new matter is introduced by this Amendment. Claims 1, 2, 5-10, and 12-14 are in the case.

The Aoai disclosure

Claims 1-4 and 10-14 were rejected under 35 USC 102(e) as being anticipated by US 6245485 (Aoai). Claims 5-9 and 11 were rejected under 35 USC 103(a) as being unpatentable over Aoai. These rejections are respectfully traversed.

The Aoai patent discloses a positive resist composition that is exposable using far ultraviolet radiation having a wavelength of 220 nm or less. The compositions comprises (A) a compound that generates an acid on irradiation with an active light ray or radiation, (B) a resin having a polycyclic alicyclic group and a carboxyl group, said resin being either (1) a resin having at least one repeating unit with a polycyclic alicyclic group on a side chain, represented by the formulas XXII, XXIII, or XXIV, or (2) a resin containing at least one repeating unit having an alicyclic group on the main chain, represented by the formulas II or III, and (C) a compound represented by the formula XIV, and wherein the resin component (B) and the compound component (C) are crosslinked. The crosslinked product is insoluble in alkali developer and is decomposable by the acid generated on irradiation to increase the solubility in alkali developer (claim 1). As specific examples of XXII, the formulas (a4), (a11), (a20), and (a22) are exemplified in columns 16, 17, and 19.

Aoai describes the advantages of his approach as follows:

> ... a positive resist composition suitable for the exposure using a light source of 220 nm or less, particularly an ArF excimer laser beam (193 nm) can be obtained.
> ... the positive resist composition ensures ... high transmissivity, high sensitivity, good resolution, sufficiently high resistance against dry etching, satisfactory adhesion to the substrate, and superior developability.... Accordingly, the positive resist composition can be effective used in the formation of a fine pattern necessary for producing a semiconductor device.

Column 95, lines 48-62.

The Asakawa discl sure

Claims 1-14 were rejected under 35 USC 103(a) as being unpatentable over US 6,280,897 (Asakawa). The rejection is respectfully traversed.

Asakawa discloses a polymer having a repeating unit represented by the general formula (1A), (1B), or (4) – claims 1, 2, 5 – a unit (a cyclohexane ring or a norbornane ring) represented by the formula (2) or (3) as the repeating unit of formula (1B), and a unit (including a 2-hydroxy-4-methylcyclohexyl group) represented by the formula (5) as the repeating unit of formula (4) – Abstract; column 3, line 4 to column 6, line 4; column 8, line 21 to column 9, line 55. Claim 12 in the Asakawa patent describes, as preferable hydrophilic groups, hydroxyl groups or carboxyl groups. The Asakawa patent describes advantages of its invention as follows:

> ... there is provided a photosensitive composition which is capable of forming a resist pattern having excellent transparency to ultra-short wavelength light such as ArF excimer laser, high sensitivity, high resolution and excellent dry etch resistance.

Column 86, lines 1-6.

The present invention

Concerning formula (2) in the present invention, neither Aoai nor Asakawa teaches or suggests a combination of an adamantane backbone and an oxygen-containing group. Regarding formulas (2d) and (2e) in present claim 9, these two references fail to teach or suggest a combination of a decalin or

tricyclo[5.2.1.$0^{2,6}$]decane ring and an oxygen-containing group substituted on a specific position of the ring.

With respect to formulas (1) and (2), the examiner alleged that R^{44} and R^{13} are terpene rings such as adamantyl. However, Asakawa never discloses adamantyl as an embodiment of R^{13} and R^{44}. Moreover, adamantane does not belong to the category "terpene", as is apparent from the fact that adamantane is not described as a terpene hydrocarbon in IUPAC Organic Nomenclature Rules Section A, 1969, Butterworths, London (1971). Thus the combination of the bulky adamantane ring with the oxygen-containing group is not motivated by the Asakawa disclosure.

Accordingly, the subject matter of claims 1 and 9 in their present form is both novel and unobvious.

Furthermore, the present invention shows unexpected results. That is, according to Aoai, although the unit (a20) has an adamantane backbone, adhesion to a substrate would not be improved because the adamantane backbone is bulky and the unit has no oxygen-containing group. Moreover, since according to not only the unit (a22) of Aoai but also the unit (1a) or (4) of Asakawa, where rings have carboxyl groups or hydroxyl groups, adhesion properties may be improved but the units would not be hydrolyzed effectively by acid generators. Incidentally, Applicants point out that the position of substitution on rings such as tricyclo[5.2.1.$0^{2,6}$]decane, decalin, and adamantane plays an important role in adhesion to a substrate.

In accordance with the present invention, adhesion and resolution are improved and fine-line patterns are formed with high accuracy by the specified combination of specific rings and oxygen-containing groups. Such results could not have been predicted based upon the disclosures of the Aoai and Asakawa references.

Conclusion

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Richard Gallagher (Reg. No. 29,781) at (703) 205-8008 to conduct an interview in order to expedite the prosecution of the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,
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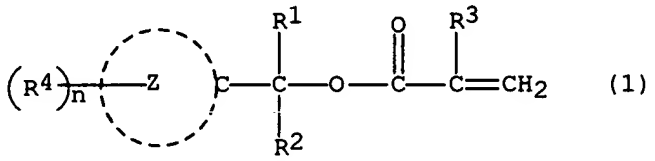
Attachment: Version with Markings to Show Changes Made

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

The claims have been amended as follows:

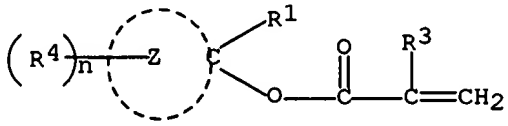
1. (thrice amended) An acid-responsive [acid responsive] compound represented by the following formula (1)



(1)

wherein R^1 represents a hydrogen atom, an alkyl group or a cycloalkyl group; R^2 [p]represents an alkyl group or a cycloalkyl group; R^3 represents a hydrogen atom or a methyl group; R^4 represents a hydrogen atom, a halogen atom, an alkyl group, an oxygen-containing [oxygen containing] group, an amino group or an N-substituted amino group; n represents an integer of not less than 1; with proviso that all R^4s are not concurrently hydrogen atoms, and R^4 may be varied according to n; the Z ring represents an adamantane ring [a polycyclic alicyclic hydrocarbon ring]; R^1 and R^2 may, jointly and together with adjacent carbon atom, form an alicyclic hydrocarbon ring,

or by the following formula (2)



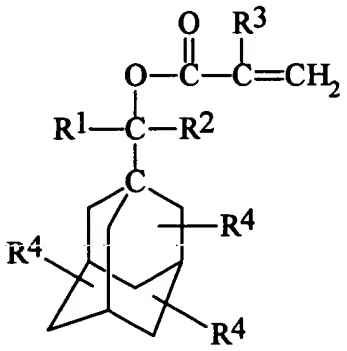
(2)

wherein R^1 represents an alkyl group or a cycloalkyl group; R^3 represents a hydrogen atom or a methyl group; R^4 represents a hydrogen atom, a halogen atom, an alkyl group, an oxygen-containing group, an amino group or an N-substituted amino group; n represents an integer of not less than 1; with proviso that [all R^4s are not concurrently hydrogen atoms, and] R^4 may be varied according to n; and Z represents an adamantane ring, [a polycyclic alicyclic hydrocarbon ring selected from the group consisting of spiro hydrocarbon rings, ring assembly hydrocarbon rings, fused-ring hydrocarbon rings, and bridged rings,]

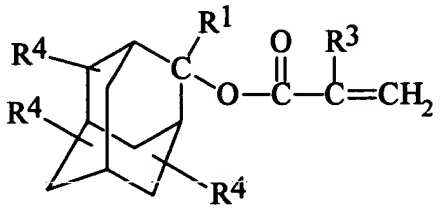
wherein at least one of the R^4s in formula (1) and at least one of R^4s in formula (2) is an oxygen-containing group selected from the group consisting of oxo groups, hydroxyl groups, alkoxy groups, carboxyl groups, alkoxycarbonyl groups, cycloalkyloxycarbonyl groups, aryloxycarbonyl groups, aralkyloxycarbonyl groups, hydroxymethyl groups, carbamoyl groups, N-substituted carbamoyl groups, and nitro groups [the bridged ring is selected from the group consisting of tricyclic hydrocarbon rings, tetracyclic hydrocarbon rings and hydrogenated dimers of dienes].

2. (amended) The acid-responsive compound according to Claim 1 having [wherein, in] the formula (1), wherein R^1 is a hydrogen atom and R^2 is [a hydrogen atom or] a straight-chain or branched-chain C_{1-4}alkyl group.

7. (amended) The acid-responsive compound according to Claim 1, which is represented by the following formula (1a) or (2a):



(1a)



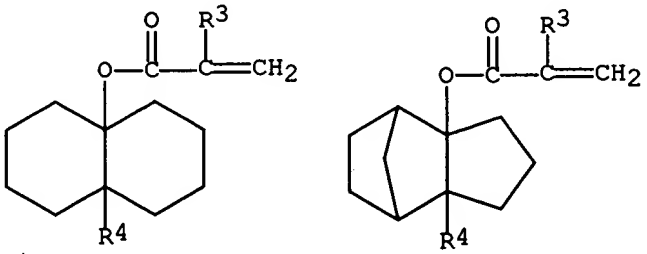
(2a)

wherein R^1, R^2 and R^3 are as defined above; and the R^4s may be the same or different from each other and each represents a hydrogen atom, a halogen atom, an alkyl group, an oxygen-containing group, an amino group or an N-substituted amino group[; with the proviso that all R^4s are not concurrently hydrogen atoms].

8. (amended) The acid-responsive compound according to Claim 7, wherein R^1 in [the] formula (1a) is a hydrogen atom or a straight-chain or branched-chain C_{1-4} alkyl group, and R^1 in [the] formula (2a) is a straight-chain or branched-chain C_{1-4} alkyl group; R^2 is [a hydrogen atom or] a straight-chain or branched-chain C_{1-4} alkyl group; R^3 is a hydrogen atom or a methyl group; at least one of R^4s is at

least one oxygen-containing group selected from the group consisting of oxo groups, hydroxyl groups, [an] alkoxy groups, carboxyl groups, [an] alkoxycarbonyl groups, [a] cycloalkyloxycarbonyl groups, [an] aryloxycarbonyl groups,[an] aralkyloxycarbonyl groups, hydroxymethyl groups, carbamoyl groups, [an] N-substituted carbamoyl groups, and nitro groups.

9. (amended) An acid-responsive compound represented by the following formula (2d) or (2e)[;]:

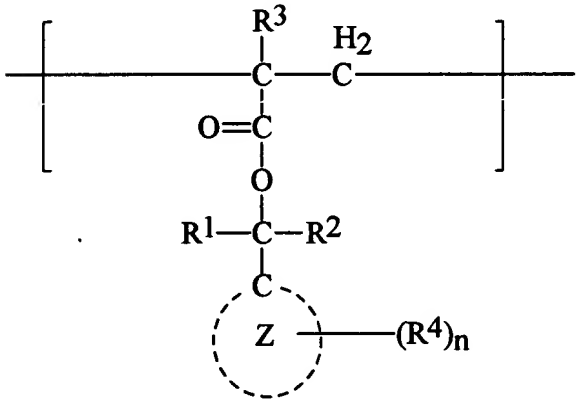


(2d) (2e)

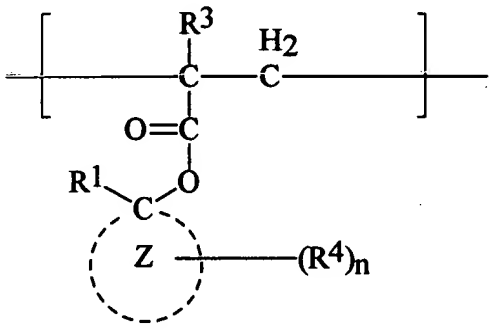
wherein R^3 represents a hydrogen atom or a methyl group; R^4 represents [a hydrogen atom, a halogen atom, an alkyl group,] an oxygen-containing group selected from the group consisting of oxo groups, hydroxyl groups, alkoxy groups, carboxyl groups, alkoxycarbonyl groups, cycloalkyloxycarbonyl groups, aryloxycarbonyl groups, aralkyloxycarbonyl groups, hydroxymethyl groups,

carbamoyl groups, N-substituted carbamoyl groups, and nitro groups [, an amino group or an N-substituted amino group].

10. (amended) A photoresist resin composition comprising (i) a polymer having at least [a] one unit represented by the following formula (11) or (12)[;]:



(11)



(12)

wherein R^1, R^2, R^3, R^4, the Z rings, and n are as defined in Claim 1 and (ii) a photoactive acid precursor.

12. (amended) The photoresist resin composition according to Claim 10, which contains 0.1 to 30 parts by weight of the photoactive acid precursor (ii) relative to 100 parts by weight of the polymer (i).

13. (amended) The photoresist resin composition according to Claim 8, wherein the polymer is a copolymer.

14. (amended) A method of forming a pattern, which method comprises

subjecting a layer comprising the photoresist resin composition of Claim 8 formed on a substrate to pattern exposure and

developing the exposed coating layer to form a pattern.